Building stem cell niches from the molecule up through engineered peptide materials.

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Public Summary:
The native stem cell niche is a dynamic and complex microenvironment. Recapitulating this niche is a critical focus within the fields of stem cell biology, tissue engineering, and regenerative medicine and requires the development of well-defined, tunable materials. Recent biomaterial design strategies seek to create engineered matrices that interact with cells at the molecular scale and allow on-demand, cell-triggered matrix modifications. Peptide and protein engineering can accomplish these goals through the molecular-level design of bioinductive and bioresponsive materials. This brief review focuses on engineered peptide and protein materials suitable for use as in vitro neural stem cell niche mimics and in vivo central nervous system repair. A key hallmark of these materials is the immense design freedom to specify the exact amino acid sequence leading to multi-functional bulk materials with tunable properties. These advanced materials are engineered using rational design strategies to recapitulate key aspects of the native neural stem cell niche. The resulting materials often combine the advantages of biological matrices with the engineering control of synthetic polymers. Future design strategies are expected to endow these materials with multiple layers of bi-directional feedback between the cell and the matrix, which will lead to more advanced mimics of the highly dynamic neural stem cell niche.

Scientific Abstract:
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